ARMY RESEARCH LABORATORY

Targeted Human Factors and Ergonomics Recommendations for Materiel and Concept Developers from the 2013 US Army Capabilities Integration Center Dismounted Non-network-Enabled Limited Objective Experiment (ARCIC DNNE LOE)

by Frank Morelli, Gabriella B Larkin, John Reinhart, Keith Gunn, Michael P Geller, and Charles L Hernandez

ARL-TN-0645 **November 2014**

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14. ABSTRACT

The US Army Manpower and Personnel Integration program, known commonly as MANPRINT, is the process by which a system's suitability and optimization for Soldier use is assessed prior to equipment fielding. One way to identify potential Soldier-system interaction issues associated with a particular system, and to optimize system design toward maximizing Soldier-system performance and Soldier acceptance of the system, is through participation in experimentation events designed to comprehensively address the interaction between distinct and separate systems within an operational backdrop. This report summarizes feedback provided during the 2013 US Army Capabilities Integration Center Dismounted Non-network-Enabled Limited Objective Experiment across technologies employed by the dismounted Soldier.

15. SUBJECT TERMS

human factors, MANPRINT, dismounted, network, small-arms weapon systems, close combat systems, power, communications, situational awareness, Soldier-worn equipment, load configuration, Soldier-system integration

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1. Introduction

The US Army Manpower and Personnel Integration program, known commonly as MANPRINT,[1,2] is the process by which a system's suitability and optimization for Soldier use is assessed prior to equipment fielding. A MANPRINT practitioner's ability to influence system design and refine system capability is maximized when human factors analysis is applied early in the developmental stages of a program. One way to identify potential Soldier-system interaction issues associated with a particular system, and to optimize system design toward maximizing Soldier-system performance and Soldier acceptance of the system, is through participation in experimentation events designed to comprehensively address the interaction between distinct and separate systems within an operational backdrop. While this method for influencing design and product development relinquishes the empirical control necessary for direct experimentation, it also provides a powerful benefit—the ability to observe and gain insight into how a particular system interacts with other systems being employed by teams of Soldiers in an operational setting. Such interactions, revealed in the course of quasi-experimental events (i.e., events that feature selective emplacement of controls to allow for observation and user feedback during operational scenarios), often reveal critical user operational requirements. This is potentially significant, given that such observations are often delegated to the status of assumptions in isolated experimental paradigms and during concept design and modeling. Large-scale experimentation therefore makes for a valuable venue to capture and record insight into "system of systems" functioning.

The Dismounted Non-network-Enabled Limited Objective Experiment (DNNE LOE) was a first of its kind, large-scale operational experimentation event designed to examine the effects of employing Soldier systems in the absence of network connectivity and support. The event was focused on squad tactics and operations, and it employed a number of new technologies and conceptual surrogates to examine their efficacy and patterns of interaction as Soldiers engaged an opposing force within operational scenarios. The technologies assessed during the DNNE LOE spanned various technical domains and addressed a wide variety of capabilities that include lethality, maneuverability, and Soldier protection. The technologies and capabilities they represent were ranked in accordance with a prioritization list developed by the US Army Capabilities Integration Center (ARCIC), a Training and Doctrine Command (TRADOC) element tasked with developing concepts and capabilities, evaluating proposed modernization solutions, and integrating these capabilities across Army doctrine, organization, training, materiel, leadership and education, personnel, and facilities. The US Army Research Laboratory's Human Research and Engineering Directorate supported ARCIC, US Army Materiel Command developers, and the DNNE LOE with targeted MANPRINT analysis across many of the systems

employed during the event by emplacing human factors engineers with specialized domain expertise across domains that include small-arms, field artillery, systems integration, load carriage/configuration, and explosives.

The recommendations and commentary made herein are intended to demonstrate the value of early human factors assessments during operational experimental events. For many of the observations that are reported, exact frequencies for Soldiers reporting specific effects were unavailable because of limitations on direct access for human factors practitioners during the event. Nevertheless, a summary of MANPRINT observations and recommendations for the technologies evaluated during the DNNE LOE is summarized in this report based on anecdotal Soldier assessment commentary and observations of event vignette execution that were documented during the event.

2. Summary of Human Factors Analyses across Selected DNNE Systems and Surrogates

2.1 Small-Arms Weapon Systems

2.1.1 Squad Designated Marksman (SDM) Rifle

The SDM rifle employed during the DNNE LOE was a compact, lightweight variant of the M110 Semi-Automatic Sniper System (SASS), featuring an 18-inch barrel, collapsible buttstock, new suppressor, and new optic. Employment of an SDM-specific rifle was intended to reduce Soldier load (i.e., by carrying a single small-arms weapon system versus 2—a carbine and a sniper rifle), improve weapon ergonomics, and improve Soldier mobility and equipment portability.

All feedback and performance data for the SDM rifle system is based upon the input of 3 Soldiers selected to fill this role for the purposes of this experiment. It is also acknowledged that there is no one weapon that can fully provide the capabilities of 2 purpose-specified weapon systems. However, the Compact SASS (C-SASS, Fig. 1) used here as the SDM rifle surrogate was fairly well received with respect to its ability to reasonably allow the SDM to fulfill the portion of his role that is currently dependent on both the M14 Enhanced Battle Rifle (EBR) and the M4A1 carbine. Soldiers made recommendations to improve C-SASS suitability as an SDM rifle, such as its physical appearance (i.e., color), to allow it to blend in with the rest of the squad's weapons. However, Soldiers also stated that they were more likely to take the C-SASS over the M14-EBR on missions, as it is more similar to the M4 carbine in appearance relative to the M14-EBR. This feature is tactically valuable so as not to distinguish the SDM-assigned Soldier from among other squad members while in sector. The SDM Soldiers also recommended that a forward assist be installed on the weapon to help in the case of malfunctions, and indicated that a better sling may be required to optimize portability, though it

was unclear if this was based on comfort or positioning concerns while maneuvering and shouldering the weapon. SDM feedback on the optic used on the C-SASS indicated that the incorporation of a magnification selection lever (i.e., "cat-tail" lever), as was incorporated on the Squad Common Optic (SCO) surrogate (see Section 2.1.2), would be of great benefit to facilitate quick and easy transition between power settings. There was positive feedback associated with the use of the Sniper Quick Fire Sight in conjunction with the primary optic for short ranges. SDMs also indicated some difficulty with sight picture acquisition and reticle crowding with the 3.5–18× optic used on the C-SASS, relative to the 3–10× optic used on the M14-EBR, citing a preference for the simplicity of the mil-dot reticle, among other features. However, after the force-on-force portion of the experiment, SDMs reported an advantage from the 3.5–18×'s extended range.

Fig. 1 Compact Semi-Automatic Sniper System (C-SASS), surrogate example

2.1.2 Squad Common Optic (SCO)

The SCO (Fig. 2) employed during the DNNE LOE was a variable-magnification day optic intended to combine the capabilities of the M68 Close-Combat Optic (CCO) and the M150 Rifle Combat Optic (RCO) in one system designed to provide both rapid target engagement at close ranges and improve target identification capabilities at extended ranges.

Fig. 2 SCO, surrogate example

Soldier feedback strongly supported the need for the variable power concept and that the 1–6× was an appropriate range of magnification. Following the force-on-force portion of the experiment, Soldiers indicated that the increased magnification capabilities allowed for more confidence in positive identification across an extended range relative to currently fielded optics (i.e., the M68 CCO [1× magnification] and M150 RCO [4× magnification]). Across DNNE data collection events, Soldiers indicated that they tended to use the optic on either 1× or 6× and did not typically adjust to intermediate power levels, citing time as the driving factor. However, during the force-on-force portion of the experimentation event, Soldiers indicated that they had adjusted the magnification power to accommodate the task at hand throughout the course of the event. The magnification selector lever and the ability to adjust illumination facilitated usability.

Because of eye box (i.e., multidirectional eye relief) constraints associated with magnified optics, many Soldiers experienced difficulty with sight picture acquisition and maintaining the red dot while moving. Soldiers also recommended a simplified reticle, but they did not get the chance to fully evaluate the functionality of the reticle at this event. The feedback suggests that an alternative/modification is required for optimizing performance in short-range dynamic (e.g., while moving) engagements that require quick, easy, and forgiving sight picture acquisition. Additional emphasis on training is also needed for performance optimization with a variable power optic: As the events progressed, Soldiers anecdotally indicated increasing levels of comfort with the function and use of the optic.

2.1.3 M4A1+ Carbine

The M4A1+ (Fig. 3) employed during the DNNE LOE was intended as a product improvement to the US Army standard M4 carbine, featuring the following improvements: free-floating heavy barrel, 2-stage match-grade trigger system with full-auto capability, quad rail forend, and an ambidextrous safety/fire control lever.

Fig. 3 M4A1+ carbine, surrogate example

It is difficult to determine the extent to which any of the features of the M4A1+ independently impacted Soldier performance in this event due to subtle interactive effects among the different weapon features and components. However, the extended forward rail was regularly described as having improved stability, grip placement, and comfort, with anecdotal verbal feedback suggesting that it may allow for quicker maneuverability and engagement times plus greater

accuracy. However, to quantitatively determine if these effects can be attributed to the extended forward rail, empirical evaluation of the forward rail's impact on Soldier-M4A1+ performance is required.

2.1.4 Small-Arms Signature Reduction Systems

Small-arms signature reduction systems (i.e., suppressors, Fig. 4) are small-arms weapon system noise and visual signature reduction devices that also reduce recoil energetics transferred to the shooter during weapon firing. Typically, suppressors positively affect weapon controllability by reducing recoil and/or muzzle blast direction, especially during target engagements that feature multiple shots fired in close temporal contiguity.

Signature reduction systems may be helpful (i.e., contributing to improved controllability) or detrimental (i.e., adding weight and length, thereby changing balance, weight, and handling characteristics) depending upon mission constraints and as such should not be integral to the weapon system. The benefits of the suppressors extend beyond signature reduction and increased stealth. In this event, Soldiers attributed reduced recoil and muzzle rise, improved situational awareness, and improved communication capabilities to the suppressor. Ideally, reduction in suppressor size/weight is required to optimize Soldier-system interaction given the potential for negative handling and aiming effects associated with longer and heavier form factor suppressors.

Fig. 4 Small-arms signature reduction muzzle brakes/suppressors, surrogate examples

2.1.5 Lightweight Small-Arms Technology Cased Telescoped Lightweight Machine Gun (LSAT CT LMG)

The LMG (Fig. 5) employed during the DNNE LOE was chambered for 5.56-mm CT ammunition. The system was gas powered and featured a pivoting chamber that moved out of line for feeding and in-line with barrel bore axis during firing. The LSAT system (~10 lb) weighed less than the current-issue Squad Automatic Weapon (SAW, ~20 lb) and featured a quick-change barrel.

Soldiers reported anecdotally that the total system's light weight facilitated firing and transitioning between shooting postures relative to the heavier M249 and that recoil mitigation systems improved sight picture maintenance and target accuracy. Soldiers indicated that the overall system weight reduction relative to the current M249 would allow the squad the option to carry more ammunition and/or more equipment while achieving mobility performance characteristics comparable to current human-system performance. The system experienced frequent malfunctions during the force-on-force event that may be in part due to the blank ammunition fired during that exercise.[3] Soldiers suggested that the action required to clear malfunctions was too time-consuming for practical operational use; Soldiers must disassemble the weapon system to remedy malfunctions. They also said effective lubrication of the weapon system took too long. The Soldiers, who required a field expedient manner in which to address malfunctions, considered these unreasonable requirements.

Fig. 5 LSAT CT LMG

2.2 Close Combat Systems

2.2.1 XM210 Lightweight Dismounted Infrared (IR) Hand-Held Signal

The XM210 (Fig. 6) employed during the DNNE LOE was a hand-held, IR parachute flare designed for battlefield illumination. The utility of this signal is based upon the assumption that enemy personnel do not have access to modern or effective night vision equipment. If the night vision capabilities of the threat are modernized or if they are unknown, the use of this flare presents a Soldier survivability issue, as its use would inadvertently alert the threat to Soldiers' position. Soldiers at this event stated that, tactically, the squad must assume the threat does have access to night vision devices. Furthermore, after the force-on-force event, Soldiers reported that the IR flare is visible with the naked eye in some conditions, thereby increasing the risk to Soldier survivability. Additional feedback suggests that the trajectory of the flare is erratic, and that loading and carrying the flare increases the Soldier's weight differential relative to the 40-mm flare.

Fig. 6 XM210

2.2.2 Pen Flare Signaling Device (PFSD)

The PFSD (Fig. 7) employed during the DNNE LOE was a multishot, hand-held, and hand-launched flare system. Intended usage included signaling, convoy protection, urban operations, and escalation of force.

Fig. 7 PFSD

Soldiers anecdotally regarded the PFSD as more expedient to use, with a more manageable shape and weight than the XM210. Soldiers provided positive feedback on the availability of color options for the flare. However, some improvements appear to be required to optimize Soldier-system use. Soldiers recommended a modification to allow for rapid reloading, specifically to mitigate the difficulty experienced in using the pen flare while wearing tactical gloves. More importantly, the firing mechanism lacks the required force to breach overhead canopy and achieve sufficient altitude. The PFSD also requires improved illumination characteristics: Soldiers anecdotally reported that the flare does not provide illumination with sufficient duration or brightness for operational illumination. However, Soldier feedback suggested that the PFSD was preferable to other available systems for providing immediate location information in unobstructed areas (i.e., areas without canopy).

2.2.3 Man-Portable Line Charge (MPLC)

The MPLC (Fig. 8) employed during the DNNE LOE was a lightweight man-portable rocket-launched explosive line charge designed for rapid small-unit explosives clearing operations.

Fig. 8 (Clockwise from top right) MPLC, detonation, and carried in a rucksack by a Soldier

Soldiers anecdotally reported that the MPLC would not add operational value if employed in the manner in which it they were instructed to use it during the DNNE LOE. Although Soldiers can use the MPLC to clear a lane, they must still wait for an explosive ordnance disposal team to clear the area for movement after initiating the MPLC. Because of that and the time required to assemble the system, estimated by Soldiers to be roughly 5–10 min, Soldiers anecdotally indicated that they would choose to find a faster route rather than employ this system for area clearance. Soldiers recommended that the MPLC be used as a company/platoon-level asset and be repurposed as an ambush line. Soldier feedback also indicated that the MPLC’s weight, carrying instability, and shape prohibited efficient mobility, would cause pain and discomfort during dismounted carry, and potentially slow operational tempo (e.g., during the force-on-force event, Soldiers reported that it became entangled in tree limbs). Soldiers anecdotally reported that a tool should be issued to assist in securing the MPLC for effective operation. During the DNNE LOE, Soldiers anecdotally indicated that they could not effectively stabilize the MPLC while adjusting aim on uneven terrain.

2.2.4 Lightweight Individual Assault Munition (IAM)

The IAM (Fig. 9) employed during the DNNE LOE was designed as a lightweight, recoilless, multitarget munition capable of defeating bunkers, hardened structures, and light armored vehicles.

Soldiers anecdotally reported that having 2 different ammunition types for the IAM system is inherently risky given the potential to mistakenly load the wrong ammunition during operations. Having 2 identical ammunition rounds provides redundancy in case of a miss on the first shot. For layered compound walls, Soldiers suggested that having 2 copies of the same ammunition

would allow Soldiers to penetrate the outer and inner walls or barriers. Soldiers deemed the estimated 45-s temporal fuse before detonation to be impractical. Soldiers suggested that the system combustion process should be able to be initiated and halted before detonation if it becomes necessary not to use the system. The red dot aiming process was deemed beneficial given the positive training transfer from the CCO. Soldiers also commented that being able to fire without back blast is very beneficial when considering the safety of personnel firing the system from enclosed spaces.

Fig. 9 Computer model image of a lightweight IAM (left) and detonation (right)

2.2.5 XM Mk3A3 Offensive Hand Grenade System

The Mk3A3 offensive hand grenade (Fig. 10) employed during the DNNE LOE was designed to produce casualties during close combat while minimizing danger to friendly personnel. Alternate applications include concussion effects in enclosed areas, blasting, and demolition.

Soldiers rejected the idea of replacing the M67 grenade, or any other existing grenade, as the Mk3A3 was not perceived to be a complete functional replacement for any of the existing grenade systems. However, Soldiers anecdotally suggested that a moderate blast version of the Mk3A3 could increase room-clearing effectiveness. Soldiers perceived the Mk3A3 as a "flash bang" grenade with a spatially limited kill zone as an additional feature. However, the extended fuse duration may reduce the effectiveness of the grenade given that that the current configuration allows for sufficient time for the threat to retreat from the grenade. Soldiers expressed concern that the greater blast of the Mk3A3 poses a significant health hazard to Soldiers (e.g., blast wave concerns for traumatic brain injury). The health hazard concern was amplified by the system's tendency to bounce and roll unpredictably (i.e., "like a football"), and therefore Soldiers would not want to throw it within close proximity to friendly personnel. Soldiers attributed this issue to the shape and size, and added that part of the problem was that the grenade was too thin, making it more amenable to tossing versus accurate throwing.

Fig. 10 XM Mk3A3 hand grenade and sample detonation

2.3 Soldier Power: Modular Universal Battery Charger (MUBC) with Solar Blanket, Next-Generation Solar Panels, and Batteries

The MUBC (Fig. 11) employed during the DNNE LOE was designed as a small, lightweight charging solution for austere operational environments that is capable of drawing power from a variety of sources. Lightweight, flexible solar panels were also employed to evaluate charge time under operational conditions.

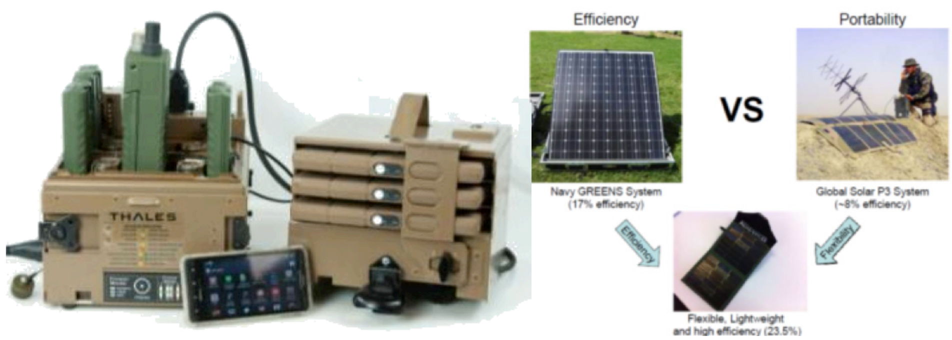

Fig. 11 Soldier power systems, surrogate examples

The utility of this capability in an operational context is currently limited due to the direct solar access requirement. Using the system under canopy or any type of cover or obscurant (e.g., on a patrol base) defeats system effectiveness. However, upon exposing the system to direct sunlight, Soldiers repeatedly received a “battery too hot” warning, requiring them to use the solar flap/blanket to shade the battery. The ports on the systems did not charge separate systems with equivalent charge distribution. There was a charging precedence hierarchy that was not obvious to the individual Soldier using the system, resulting unexpectedly in dead batteries during operations. Soldiers suggested that the battery charging priority scheme should be clear, intuitive, and transparent to the end user through the interface, and not dependent on new equipment training. Soldiers further recommended that the priority scheme be adjustable at the user level.

Soldiers remarked that the system was quickly and easily deployed and activated, and indicated that they would use a solar panel mounted on an individual Soldier’s back to charge small carried

items that require continuous power during operations. However, Soldiers suggested that the solar panel and battery be made smaller for squad operations. In its current configuration the system was deemed more appropriate for platoon-level operations. Given the shape of the system, Soldiers deemed the distribution of 3 systems to a single platoon to be overkill. Soldiers determined that the roughly 50 ft^2 (estimated) of solar panel lying out on the ground to charge systems during operations was impractical.

Soldiers suggested that the system shape and size when configured for transport made it too large and unwieldy, occupying approximately half a rucksack worth of volume. It was suggested that the charger design incorporate a smaller form factor to make it practical for squad operations. In its current configuration it was deemed practical only as a resupply equipment item. Soldiers recommended that 9 individual Soldiers carrying 3 smaller battery systems would be more practical and effective than having one Soldier carrying one large and heavy battery system. A more compact, smaller charger that could attach to a backpack would be a better design and make it more feasible and practical for carrying. Soldiers recommended a modular approach with conformal batteries or batteries of different shapes to fit varying requirements and suggested that these batteries could connect together like Lego-style blocks to provide increased powered when necessary. Twenty-seven batteries were deemed too many for one squad over a 3-day mission. To justify such a large number of battery systems, Soldiers suggested that a given squad would have to be out on mission in sector for a much longer period of time.

2.4 Systems to Augment Situational Awareness

2.4.1 InstantEye

The InstantEye system (Fig. 12) employed during the DNNE LOE was designed as a portable rapid-deployment day/night-operable Soldier-launched information, surveillance, and reconnaissance aerial vehicle system.

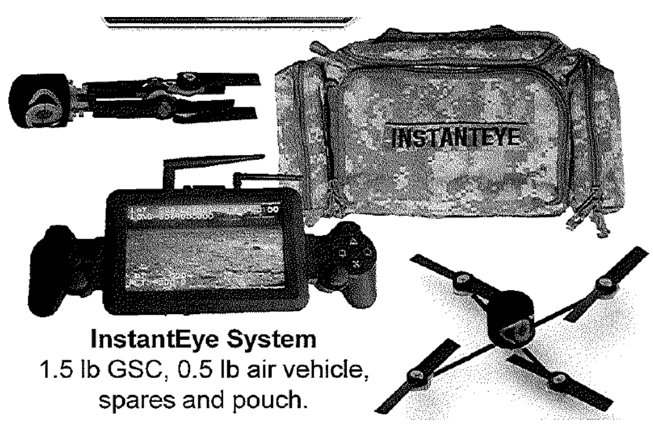

Fig. 12 InstantEye system composed of visual display and control unit, air vehicle, spares, and carrying pouch

Reconnaissance planning was conducted differently with the InstantEye system. When it achieved high altitude, it allowed the squad to observe gridlines without necessitating close physical proximity of the squad to the target. The squad also used the system to confirm tactical assumptions, though the system's resolution was insufficient for achieving detailed target or route information. The system was not used while the squad was on the move, nor was it used while executing action on the objective. The squad used the system while in a defensive posture and was able to confirm that enemy forces were not approaching.

Items for the InstantEye system that may need improvement based on human factors analysis of anecdotal Soldier feedback include the following:

- Improved fidelity and zoom given that limited zoom capability degraded the squad's ability to get detailed target or objective information.
- Relay nodes, a GPS locking feature, and target GPS (i.e., point-to-target with GPS coordinate integration).
- Integration of Modular Lightweight Load-carrying Equipment (MOLLE) for gear carrying options; how the system is carried would be critical for squad mobility. Generally Soldiers said that one could not reasonably expect such equipment to be carried by default on an individual Soldier's back. Rather, a carrying case or options for varying carry locations on Soldier-worn equipment is needed.
- Improved signal strength and battery life. These issues led to limited system effectiveness given the short range for which the system permitted effective surveillance. Roughly 600 m was the best-case scenario during the event.

2.4.2 Maneuver and Fires Integrated Application (MaFIA)

The MaFIA system employed during the DNNE LOE was designed to provide forward observers and small units with the capability to enable precision targeting independent of higher network asset integration and support.

Soldiers anecdotally and nonspecifically described MaFIA map display and notation features as useful but suggested that MaFIA should be integrated into NETT Warrior (formerly Ground Soldier System) rather than employed as a stand-alone system. The need for a single integrated maneuver and fires application within NETT Warrior was especially evident during squad movements. Soldier feedback also suggests that a human factors engineering effort would be beneficial to optimizing Soldier-system use and increasing Soldier acceptance and Soldier trust in automation. Reported human factors issues included the inability to reliably initiate a call for fire due to the MaFIA system's propensity for screen freezing, powering down spontaneously, and timing-out issues requiring password re-entry for access. Buttons and icons were also difficult to engage or activate and often resulted in the wrong function being activated. Soldiers suggested that the large rotating target icon/compass required redesign and optimization, as it

obscured required map features. The system also incorrectly indicated that Soldiers were never facing south. MaFIA cases were easily broken during operations, and screen lighting was a concern for Soldiers during night operations, though the signature reduction feature was noted as a positive feature. Condensation issues with the screen also caused access and system function failures.

2.5 System Integration Observations

The Soldier/squad integration effort employed during the DNNE LOE was designed to inform decisions to review standard configuration changes for Soldier-worn equipment in conjunction with program milestones/decisions.

The Product Director, Soldier Systems and Integration (PD SS&I) conducted surveys and collected data during the base case and experimental case after-action review sessions to evaluate equipment configuration and integration for the members of a dismounted rifle squad. The data gathered pertained to the compatibility and integration of Soldier gear including clothing, equipment, and weapons for baseline and mission-specific Soldier loads (Fig. 13). Results showed that there was little apparent consideration for equipment design for integration as more and more items are added to the dismounted Soldier’s load, which adversely impacts Soldier performance. Feedback from DNNE participants included compatibility issues with load-bearing equipment such as rucksacks and assault packs, body armor, hydrations systems, pouches, clothing, and weapons. Some examples of integration issues that were identified include the following:

- The rucksack and Improved Outer Tactical Vest (IOTV) body armor do not fit or work well together.
- The medium assault pack limits the ability to integrate and configure additional squad equipment. Soldiers would prefer external attachment points that allow them to tailor the load to the mission and better distribute the weight.
- The assault pack has no support on the hips and carries the weight too low. The shoulder straps do not fit properly over the IOTV.
- The hydration system, IOTV, and assault pack are not designed to fit well together. The hydration system tends to get crushed and broken. Soldiers would prefer a design that integrates the hydration system seamlessly between the IOTV and assault pack.
- The IOTV does not integrate the load very well. It needs to allow for multiple load carrying configurations and retain items without allowing them to flop around.
- The tactical assault panel (TAP) system restricts use of the MOLLE straps on the IOTV, limiting space. It wraps around smaller personnel making it difficult to reach ammo, interferes with IOTV release, and does not hold gear in place very well.

- Pouches do not protect sensitive items like optics very well. Soft cloth and hook-and-loop construction made quick magazine changes difficult, and grenade pouches were ineffective with the TAP system.
- Cargo pockets on pants are restricted when kneepads are worn. They also cut off circulation.
- SAW linked ammo makes a lot of noise during movement and tends to fall out of the carrying pouches. Soldiers had to put extra ammo in their pockets.

Fig. 13 Soldier-worn equipment (image courtesy of US Army Program Executive Office Soldier, Project Manager Soldier Warrior)

The data gathered will help PD SS&I validate the baseline equipment configuration for the dismounted infantry Soldier, identify issues with integration of disparate equipment on the Soldier, develop a baseline Integrated Soldier System (ISS) load plan, facilitate integration requirements definition between TRADOC and materiel developers, and allow for a controlled evolution of the ISS in support of the Army equipment modernization strategy.

3. References and Notes

1. Headquarters, Department of Defense. Operation of the defense acquisition system. Washington (DC): Under Secretary of Defense for Acquisition, Technology and Logistics (US); 2008. Department of Defense Instruction 5000.02.

2. Headquarters, Department of the Army. Manpower and personnel integration (MANPRINT) in the system acquisition process. Washington (DC): Department of the Army (US); 2001. US Army Regulation 602-2.

3. The polymer/plastic casing would bend/flex and jam into the action of the weapon. Use of blank ammunition may also have changed the gas/recoil operation of the weapon, potentially affecting the normal cycling of the weapon.

List of Symbols, Abbreviations, and Acronyms

ARCIC	US Army Capabilities Integration Center
C-SASS	Compact Semi-Automatic Sniper System
CCO	Close-Combat Optic
CT	cased telescoped
DNNE LOE	Dismounted Non-network-Enabled Limited Objective Experiment
EBR	Enhanced Battle Rifle
IAM	Individual Assault Munition
IOTV	Improved Outer Tactical Vest
IR	infrared
ISS	Integrated Soldier System
LMG	Lightweight Machine Gun
LSAT	Lightweight Small-Arms Technology
MaFIA	Maneuver and Fires Integrated Application
MANPRINT	US Army Manpower and Personnel Integration
MOLLE	Modular Lightweight Load-carrying Equipment
MPLC	Man-Portable Line Charge
MUBC	Modular Universal Battery Charger PD SS&I
RCO	Rifle Combat Optic
SASS	Semi-Automatic Sniper System
SAW	Squad Automatic Weapon
SCO	Squad Common Optic
SDM	Squad-Designated Marksman
TAP	tactical assault panel
TRADOC	US Army Training and Doctrine Command

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